International Journal of Current Research in Multidisciplinary (IJCRM)
ISSN: 2456-0979
www.ijcrm.com Volume 1 Issue 4 ‖ August. 2016 ‖ PP 05-09

Functional and Pasting Properties of Baobab (*Adansonia digitata L.*) Fruit Pulp Powder

*Adekunle Adefemiwa Ayobami[1], Ibrahim Taiwo Hassan[2], Adetoro Oluwakemi Busayo[3], Mustapha Khafayat Oluwadamilola[4]
[1,2,3,4] Bioresource Development Centre, National Biotechnology Development Agency, Ogbomoso, Nigeria

Abstract
The objective of this study was to determine the functional and pasting properties of baobab (Adansonia digitata) fruit pulp powder. The Moisture content; water and oil absorption capacities; swelling index; gel strength; solubility in water at 30°C and 70°C; pasting properties as well as the microstructure of the fruit pulp powder were all determined. The water and oil absorption capacities of the fruit pulp powder were 3.83 and 3.55 mlg^{-1} respectively, while the swelling index and viscosity were observed to increase with temperature and mass. The microstructure of the fruit pulp powder revealed that the powder contains little starch granules. The gel strength was slightly stronger at 27°C than at 70°C, however, the pulp powder was sparingly soluble in water at 27°C. The Rapid Visco-Analyzer (RVA) was used to determine such parameters as the peak, trough, breakdown, setback and final viscosities, the peak time and pasting temperature were 3.46, 2.09, 1.38, 3.50, 1.42, 6.00 min and 62.30°C, respectively.

Keywords: *Baobab fruit pulp powder, functional properties, microstructure, pasting properties, temperature.*

I. Introduction

The baobab, which belongs to the family Bombacacee is a deciduous tree which is originally from central Africa and has been distributed throughout the savanna region of Africa [1]. The fruit of the baobab tree (*Adansonia digitata L.*) is oblong, pendulum on long stalks, woody and indehiscent. The seeds are attached to fibrous strands from the wall of the fruit and are embedded in a yellowish-white pulp [2]. The baobab fruit pulp which is also rich in minerals such as calcium, potassium, phosphorus and vitamins, has been found to provide soluble and insoluble fibres which constitute about 50grams/100grams of the pulp [3]. The insoluble fibers are not adsorbed by the intestine and are useful against constipation and to induce satiety, due to their ability to increase the fecal mass and stimulate peristalsis which may be useful in case of hypocaloric diet [4]. [5] reported that many of the crops which are potentially valuable as human and animal foods are underutilized and less known. These underutilized crops have been intensified to maintain a balance between population growth and agricultural productivity, partially in the tropical and subtropical areas of the world. Baobab (*Adansonia digitata*) is one of a less known and underutilized crop in Nigeria. It is primarily used as drinks and licked in raw form. [6] reported the potential of baobab fruit pulp as an effective anti-diarrhoea product which is significantly more effective than the traditional "WHO solution" for rehydration of children affected with diarrhoea. This promising but underutilized legume has potential in the formulation and development of new food product such as baked goods and milk which could provide a local alternative to imported beverage [7]. Baobab fruit pulp is employed as substitute for cream tartar (Potassium bitartrate) for the preparation of bread dough due to its high content of tartaric acid and potassium bitartrate [7]. The major constraints against the commercial application of many edible plants in the world include incomplete safety assessments, poor shelf life and inadequate supply of the crop for commercial production [8]. However, a critical survey of the literature has shown that there is little or no information available on the functional properties of the baobab fruit pulp powder. The determination of functional properties could assist in finding increasing food use and industrial application of the crop. Therefore, the specific objective of the study is to determine the functional and pasting properties of powder obtained from baobab fruit pulp.

II. Materials and Methods

2.1 Collection of Sample: The baobab fruit pulp (*adansonia digitata L.*) powder used in this study was collected from parent trees around Ladoke Akintola University of Technology, Ogbomoso. The capsules were broken to extract the white pulp and sieved into powdery form.

2.2 Determination of Moisture Content: The moisture content of the baobab pulp powder was determined by oven drying 5 g of the powder at 80°C for five hours. The sample were then cooled in a dessicator and weighed to determine the moisture loss. The powder was replicated three times and the average moisture content was determined.

2.3 Determination of Oil and Water Absorption Capacity: The oil absorption capacity was determined by the method of [9] with a slight modification. One gramme of the baobab fruit pulp powder was weighed into a test tube after which 10ml of pure groundnut oil (Gino, Packed in Malaysia) was poured in the test tube and mixed thoroughly. The test tube containing the sample was then put in the centrifuge at 1500rpm for 30 minutes after which decantation took place and the final weight of the sample was determined.
The same method of [9] was used in the determination of water adsorption capacity. The oil and water absorption capacities were calculated using the equation

$$C_{o,w=}\frac{FV-IV}{MS} \quad \text{………………………………………………. (1)}$$

Where, FV is the Volume after centrifugation (ml), IV is the Volume of the sample before centrifugation (ml) and MS is the mass of the sample (g).

2.4 Determination of Swelling Index: Swelling index of the baobab fruit pulp was considered with effect to temperature. Twenty (20) grammes of the sample was weighed into measuring cylinder. Fifty (50) ml of distilled water at varying temperatures between 40 and 60°C was added to each 20g of the sample in the measuring cylinder. It was then properly shaken together and allowed to stay for 1hour after which the final volume was taken. The swelling volume was calculated using the equation

$$S_w\,(\%) = \frac{Final\ Volume}{Initial\ Volume} \times 100 \quad \text{………………………………. (2)}$$

Where, S_w is the swelling volume.

2.5 Determination of Microstructure of Baobab Fruit Pulp: The microscopic view of the baobab fruit pulp powder was employed for characterizing the native baobab fruit with respect to appearance, shape and size of the granules [10]. A pinch of the baobab fruit pulp powder was placed on a slide on the microscope. The microscopic view of the powder was observed through the microscope at 100mm aperture.

2.6 Determination of Solubility: The method of [9] with a slight modification was adopted for the solubility test. The solubility of the baobab fruit pulp powder was determined at 30 and 70°C. 0.5g of the sample was taken accurately in a 100ml beaker with 50ml of distilled water added to it. The dispersion was stirred intermittently for 1hr and was allowed to stand overnight for proper hydration at 30°C, the dispersion was also heated at 70°C for 1hr with intermittent stirring and then centrifuge (MODEL SM902B Surgifriend Medicals England). The percentage solubility was calculated from the weight of the sample in the supernatant and in the dispersion before centrifugation.

$$Solubility\,(\%) = \frac{Weight\ of\ sample\ in\ the\ supernatant}{Weight\ in\ the\ dispersion} \quad \text{…………. (3)}$$

2.7 Determination of Pasting Characteristics: Pasting properties of the baobab fruit pulp flour determined by a Rapid Visco-Analyzer (RVA-4c, Newport Scientific Pty. Ltd, Warriewood, Australia) was carried out at IITA, Ibadan. The sample was dispersed in distilled water and heated to 80°C for 5min and cooled to room temperature. The sample was then poured into aluminum containers and stirred manually using a plastic paddle for 20-30s before insertion into the RVA machine. The heating and cooling cycles were programmed in the following manner. The slurry was held at 50°C for 1min, heated to 95°C within 3min and then held at 95°C for 2min. It was subsequently cooled to 50°C within 3min and then held at this temperature for 2min, while maintaining a rotation speed of 160rpm. The peak viscosity, trough viscosity, breakdown viscosity, setback viscosity, final viscosity, peak time and pasting temperature of the baobab fruit pulp powder were all determined.

2.8 Determination of Gel Strength: The gel strength of the baobab fruit pulp powder was determined by using hot water and cold water respectively. The gel was prepared by mixing 30g of sample with boiled distilled water. The gel was allowed to cool before being filled into a small cylindrical shape to maintain a uniform shape throughout the study. The sample was then placed underneath the penetrometer (Stanhope-Seta Limited, England) cone with the tip of the cone touching the surface of the sample after which the penetrometer pointer was set to zero. The plunger of the penetrometer was released and the cone was allowed to penetrate into the gel for a period of 5s. The depth of the

penetration was read off in 10 ths/mm on the calibrated scale. The same procedure was applicable for the gel strength using cold water.

III. Results

3.1 Functional Properties: The results of the functional properties of the baobab fruit pulp powder is shown in Table (1). The initial moisture content was found to be 11.1 % d.b. The oil and water absorption for the baobab fruit powder were found to be 3.83 and 3.55 mlg^{-1}, respectively. The swelling index revealed that the volume of the reconstituted powder increased with increase in soaking temperature while the gel strength which was tested on hot and cold water using a penetrometer revealed that the sample has a higher value 145.83 10ths/mm when cold compared to 124.17 10ths/mm when hot water was used to prepare the paste. The solubility of the baobab fruit pulp powder exhibited a slightly higher value 4.16 % at 70^{o}C than 4.06 % at temperature 30^{o}C.

Table 1: Functional Properties of Baobab Fruit Pulp Powders

PARAMETERS	UNITS	VALUES
Initial Moisture Content	(% d.b)	11.1±0.1
Oil Absorption Capacity	(ml g^{-1})	3.55± 0.359
Water Absorption Capacity	(ml g^{-1})	3.83±0.132
Swelling Volume	(%)	220±39.2
Gel Strength	(10ths/mm)	
Hot Water (70^{o}C)		124.17±3.697
Cold Water (27^{o}C)		145.83±2.642
Solubility	(%)	
30°C		4.06±0.063
70°C		4.16±0.072

3.2 Microstructure: The microscopic view of the baobab fruit pulp powder as determined using a light microscopy is presented in Plate 1. The diversity in the shape and size of baobab fruit pulp powder using light microscopy could be a useful tool in the identification of different shape and sizes.

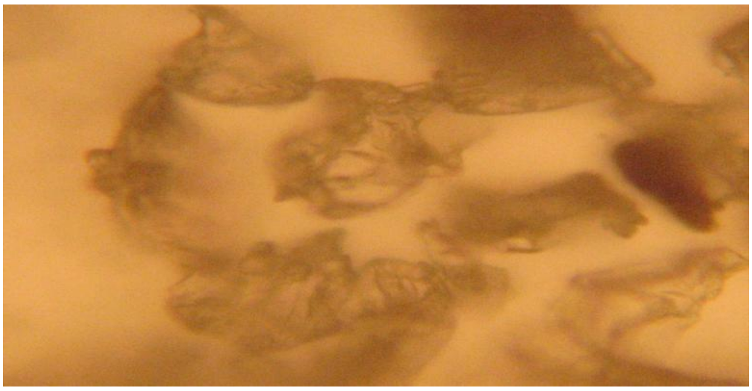

Plate 1: Microstructure of the Baobab fruit pulp powder

3.3 Pasting Characteristics: The pasting characteristics of the baobab fruit pulp powder determined by the RVA is summarized in Table (2).

Table 2: Rapid Visco-Analyzer Parameters of baobab pulp powder paste

Peak 1 (RVU)	Trough 1 (RVU)	Breakdown (RVU)	Final (RVU)	Setback (RVU)	Peak Time	Pasting Temp
3.46± 0.763	2.09 ± 0.587	1.38 ± 0.176	3.50 ± 0.707	1.42 ± 0.120	6.00±0.99	62.30±0.495

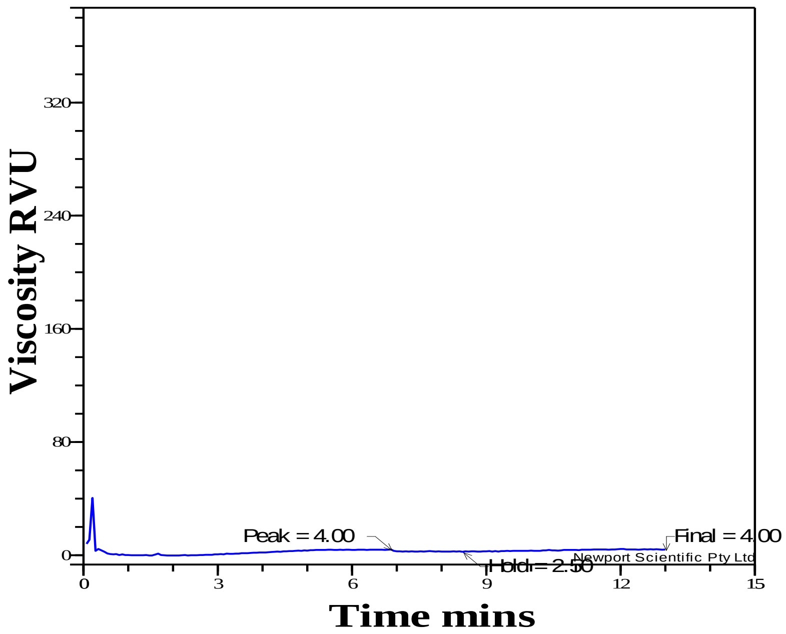

Figure 1: RVA graph of the baobab fruit pulp powder

IV. Discussion

The result of the oil and water capacities suggests that baobab fruit pulp powder may find useful applications in food systems such as bakery products. The swelling index could be due to the fact that heat processing and swelling of crude fibre occurs which leads to increase in the amount of water absorbed. There was is easy penetration of the cone into the paste in terms of the gel strength when hot water was used. The result of the solubility shows that the powder is sparingly soluble in water and cannot be used as ingredient in food that requires extensive solubility. The slight increase in the solubility of the powder at 70^{o}C could be because of the increase in temperature used. The observation is supported by the fact that solubility has been shown to positively correlate with swelling, suggesting that solubilization occurred along with granular swelling. The amylase acts both as diluents and inhibitor of swelling, especially in the presence of lipids which can form insoluble complexes with some of the amylase during swelling and gelatinization.

The microscopic view of the baobab fruit pulp powder does not conform to the shape of corn starch reported by [11]. This may be due to the low starch content in the baobab pulp powder as shown in the amylograph curve (Figure 1). Apart from the shape of the granules, another characteristic feature considered in the identification of the powder was the position of hilum which is often described as the nucleus around which the granule has grown. The hilum was not clearly seen at the centre of granules. This is an indication that baobab fruit pulp powder contains little starch contrary to the report of [2]. The pasting properties result was found to have lower values due to the significantly low starch content than the reports of [12] and [13] for Tigernut flour. The result shows that the baobab fruit pulp powder may not be a good thickening agent for any food material.

V. Conclusion

From the investigations carried out on some functional and pasting properties of Baobab (*Adansonia digitata L.*) fruit pulp powder, the following conclusions were made:

The functional properties of the baobab pulp powder show that the powder may be used as a functional ingredient in food systems such as, bakery products. The pasting properties revealed that baobab pulp powder is not a good thickener, but can only be used in food formulation with less fear of retrogradation while the microstructure of the powder indicated that baobab fruit pulp powder contains little starch.

References

[1] M. Sidibe, J.F. Scheuring, D. Tembely, M.M. Sidibe, P. Human and M. Frigg, Baobab- Homegrown Vitamin C for Africa, *Agroforestry Today,* 8(2), 1996, 13-15.

[2] A.A Nour, B.I. Magboul and N.H. Kheiri, Chemical composition of baobab, *Journal of Tropical Science,* 22(4),1980, 383-388

[3] S.S. Murray, M.J. Schoeninger, H.T. Bunn, T.R. Pickering and J.A. Marlett, Nutritional composition of some wild plant foods and honey used by Hadza forager in Tanzania, *Journal Food Composition Analysis,* 14, 2001, 3-13.

[4] P.P. Garcia and A.M. Camblor, Dietryfibre concept, classification and current indications, *Nutri. Hosp, suppl* 2,1999, 22-31.

[5] F.T. DeVries, Chufa, "(*cyperrusesculentus*) a weedy cultivar or a cultivated weed", *Economic Botany* 45, 1991, 27-37.

[6] A. Tal-Dia, K. Toure, O.M. Sarr, M.F. Cisse, P. Garnier and I. Wone, A baobab solution for the prevention and treatment of acute dehydration in infantile diarrhea, *Dakar Medicine,* 42(1), 1997, 68-73.

[7] A. Prentice, M.A. Laskey, J. Shaw, G.J. Hadson, K.C. Day, L.M.A. Jarjon, B. Dibba and A.A. Paul, The calcium and phosphurs in takes of rural Gambian women during pregnancy and lactation portish, *Journal of Nutrition,* 69, 1993, 885-896.

[8] J. Wilkinson and M. Hall, Baobab fruit: The upside down tree that could turn around the drinks industry, *Soft Drinks International,* April 2007: 26-28

[9] J. Ju and G.S. Mittal, Physical properties of various starch based fat substitutes, *Journal of Food Processing and Preservation,* 19, 1995, 361-383.

[10] T.J. Schoch and E.C. Maywald, Microscopic examination of modified starches, *Journal of Analytical Chemistry,* 28(3), 1956, 382-387.

[11] M. Sangeeta and T. Rai, Morphology and functional properties of corn, potato and tapioca starches, *Journal of Food Hydrocolloids* 20, 2006, 557-566.

[12] C. Montri and S. Manop, Pasting and rheological properties of native and anionic tapioca starches as modified by guar gum and xanthan gum, *Journal of Food Hydrocolloids,* 20, 2006, 641-649.

[13] A.K. Oladele and J.O. Aina, Chemical composition and functional properties of flour produced from two varieties of tigernut, *African Journal of Biotechnology,*6(21), 2007, 2473-2476.